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ABSTRACT

This study investigated the effectiveness of experiential learning in promoting student understanding and achievement, as compared to traditional expository instruction. Twenty third-grade students from central Virginia were divided into two heterogeneous groups and taught a single lesson on air using identical content objectives. The control group was taught through expository instruction while the experimental group learned using constructivist, experiential techniques. The expository lesson consisted of lecture, note-taking, reading, viewing diagrams, answering and asking questions, filling out worksheets, and memorizing facts and vocabulary. The experimental lesson comprised 10 hands-on experiments that the students carried out alone, in small groups, and as a class, with each student recording hypotheses and results and with discussion of the experiments taking place. Each group was given the same assessment tool, which tested both lower order and higher order learning outcomes. Results indicated that experiential learning produced higher achievement at all levels of thought for learners of all ability levels. The paper recommends that the entire educational system recognize and make use of children's natural cognitive processes through system-wide experiential education. The lesson plan and assessment instrument are appended. (Contains approximately 60 references.) (JDD)

# Teaching for Understanding: Attaining Higher Order Learning and Increased Achievement through Experiential Instruction

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Running head: TEACHING FOR UNDERSTANDING

## Abstract

This study investigates the effectiveness of Experiential Learning in promoting student understanding and achievement as compared to traditional Expository Instruction. 20 third-grade subjects from Central Virginia were divided into two heterogeneous groups and taught a single lesson on air using identical content objectives. The control group was taught through Expository Instruction while the experimental group learned using Constructivist, Experiential techniques. Each group was given the same assessment tool which tested both Lower Order and Higher Order learning outcomes. I hypothesized that Experiential Learning would yield higher achievement on the Higher Order questions but lower scores on Lower Order assessment items. Results indicate that Experiential Learning produces significantly higher achievement at all levels of thought for learners of all ability levels.

# Teaching for Understanding: Attaining Higher Order Learning and Increased Achievement through Experiential Instruction

## Introduction

Once, John Dewey asked a class, "What would you find if you dug a hole in the Earth?" The class did not respond, so Dewey posed the query another time, again receiving no response. The class' teacher chided Dewey, saying, "you're asking the wrong question." Turning to the class, she said, "What is the state of the center of the Earth?" The class replied in unison, "igneous fusion," (Bloom, 1956, p. 29).

This example illustrates one of the most compelling questions in American education: do our students understand what they are being taught? The answer to this question both in the above example and in the greater American educational system is, "no." Ironically, in the story, and often in today's classrooms, even when students are able to "master" the content presented to them in the classroom, this is far

from an accurate measure of true understanding.

In the above example, the children had memorized a given response to a specific question, but were unable to apply this information to a novel situation. In studies conducted by researchers at M.I.T. and John Hopkins University, similar results were obtained concerning comprehension of physical properties by honor-level college students following attendance in college physics courses (Gardner, 1991). Thus, even when schools appear to be successful in eliciting the desired performances for which they were designed, they fail to achieve a more crucial mission: that of instilling understanding in their students. Many students, however, lack even the shallow retention of the material afforded by current educational practices. These students often have little recall and find themselves bewildered and hostile to the voluminous amounts of fragmented information that they are expected to memorize, despite its lack of relevance to their lives.

Much has been written, from both an educational and psychological perspective concerning the reason for

this phenomenon. A majority of the research suggests that the reason for this deficiency is a fraudulent educational system. It is fraudulent in the sense that it circumvents the natural learning process of the child.

Much of this research concerning learning indicates that "Hands-on" or "Experiential" Learning supports the child's natural learning process. Through such active, discovery-based, inductive, developmentally-appropriate instruction one can achieve an effective and stimulating educational environment. Reported findings from these studies show that students are more attentive to their learning, achieve deeper and more lasting learning, and are able to apply the knowledge to novel situations. The findings of these studies indicate that it is not a question of Experiential Learning versus "Classroom" (Expository) Learning, but rather of proper learning versus inadequate, superficial learning.

Interestingly, however, recent reports including "Crossroads in American Education," produced by the National Assessment of Educational Progress suggest

that Expository Learning (using text books, worksheets, lecture, rote drill and memorization) is still the predominant vehicle for instruction in elementary schools (Von Eschenbach & Ragsdale, 1989).

The purpose of this study is to determine whether such Experiential Learning does indeed produce deeper <u>understanding</u> of concepts than traditional, Expository teaching methods. I hypothesize that due to its alignment with the cognitive functionings, developmental characteristics, and natural learning processes of the child, Experiential, Constructivist teaching will yield Higher Order, more meaningful learning as compared to Direct Instruction of the same content in a complex integrated lesson. I predict that Experiential Learning will produce drastically higher scores on questions assessing Higher Order Thought (as defined by Bloom, 1956). I also hypothesize that Experiential Learning will yield lower achievement on assessments testing only Lower Order Thought due to its focus on observable concepts instead of arbitrary social knowledge (symbolic and verbal information). I further predict that the experimental

groups' overall scores (incorporating both Higher and Lower Order assessment items) will exceed those of the control group due to their superior achievement on the Higher Order portions of the assessment tool.

In the next section, I will synthesize the findings of other prominent researchers in the field concerning Experiential and Expository Education. Following that, I will delineate the design of the study, discussing the subjects, materials, procedure, and method of analyzing the data. Next, I will present the results of my study, and finally, the findings will be discussed and conclusions will be drawn.

## Review of the Literature

### Knowledge

The goal of all human learning is the acquisition of "knowledge," no matter how simple or complex. Bloom (1956) asserts that such knowledge can be classified according to its complexity and categorized along a continuum. This continuum places the simplest (concrete) types of knowledge at the low end of the spectrum (Lower Order Thinking) and the most complex

(abstract) at the higher end (Higher Order Thinking) (Bloom, 1956). Lower Order Thinking (LOT) describes learning and thinking that occurs when learners are asked to learn pre-specified information through memorization later reciting, recalling, identifying the material, or employing rules or algorithms through repetitive routines as evaluative measures (Newmann & Wehlage 1993; McAlpine, Jewler, Weincek, & Finkbinder, 1987). In order to complete evaluative Lower Order Thinking tasks, the learner must simply recall or rearrange prior knowledge.

Higher Order Thinking (HOT) on the other hand requires students to manipulate information and ideas in ways that transform their meaning and implications. In Higher Order Thinking students use creativity, hypothesis-testing, and problem-solving in order to produce original, divergent thoughts, products, and outcomes (Newmann & Wehlage, 1993; McAlpine, Jewler, Weincek, & Finkbinder, 1987).

Bloom (1956) further defines these categories. His first three categories of learning fall under the realm of Lower Order Thinking. These include

Knowledge, Comprehension, and Application. The second three, considered Higher Order Thinking, are Analysis, Synthesis, and Evaluation.

Knowledge is defined as the remembering of ideas, material or phenomenon either through recognition or recall (Bloom, 1956). The material learned within the category of Knowledge must be easily quantifiable and remembered in isolation. Learners studying Knowledge may be asked to spell, name, cite, match, recognize, list, define, show, record, select, identify, and describe. In terms of the evaluation of Knowledge, the form, precision and exactness of the assessment cannot deviate far from the way the knowledge was originally learned (Bloom, 1956).

The next level of thinking is Comprehension, the lowest level of <u>understanding</u>. It is characterized by the ability to grasp the meaning and intent of the information without necessarily relating it to other material or recognizing its fullest implications. This is the level of learning most widely used in America's schools (Bloom, 1956). Evaluating Comprehension takes the form of defining, explaining, locating,

demonstrating, retelling, predicting, and translating. Comprehension utilizes the skills of recall and recognition.

Application is the highest level of Lower Order Thinking. It involves remembering and utilizing appropriate generalizations, theories, or principles (Bloom, 1956). Evaluation of such learning involves applying rules, and theorems to novel problems (Bloom, 1956). In the level of Analysis, learners may be asked to model, apply, survey, collect, organize, report, group, or order.

In Analysis, the forth level of Bloom's Taxonomy, the learner utilizes more advanced (abstract) levels of thought (Higher Order Thinking). Analysis involves the breakdown of material into its constituent parts and the detection of the relationships between them (Bloom, 1956). Testing this level of learning often includes asking the learner to uncover, deduce, categorize, compare, contrast, or inspect material.

Above Analysis is Synthesis, where the learner combines new and familiar information creatively but within the limits set by the material (Bloom, 1956).

In terms of evaluation, the learner might be asked to add to, create, imagine, combine, suppose, predict, play, change, hypothesize, design, invent, infer, improve, adapt, or compose.

The highest level of Bloom's taxonomy is Evaluation. This involves making judgements about the ideas, works, solutions, methods and/or sources of material. In order to perform Evaluation, the learner must combine and use all previous levels of the taxonomy (Bloom, 1956). Students may be asked to judge, debate, prove, dispute, accept, reject or criticize for evaluation of their learning.

Bloom (1956) suggests that learning occurring within the Higher-Order levels of the taxonomy is deeper, more meaningful and more lasting than that done in the Lower-Order domains. Bloom (1956) goes as far as to assert that the highest level (Evaluation) may be a prerequisite to <u>all</u> new knowledge (understanding-- as opposed to memorization). Ironically, as Bloom states, most learning in American schools occurs at the lowest levels of thinking and learning (Bloom, 1956).

Expository Learning

Bloom (1956) asserts that the most common educational objective in America is "the acquisition of knowledge or information" (p. 28). He explains that it is believed that following a unit of instruction, a student will be changed with respect to the amount and kind of knowledge possessed (Bloom, 1956). But as stated previously, such Lower Order Thinking is nothing more than memorization and recall not insight or understanding.

History.

The philosophical path leading to the Expository instructional model is easily traced. Deductive or Rote Learning dates back to Plato's "eternal forms" (fixed ideas). To be informed of these was to have a true knowledge of reality (Seeman, 1988). Western society became infatuated with such abstract, easily quantified concepts. The eminent learning theory of the time was in accordance with this view. The Mind Discipline theory, espoused by Socrates, Plato, and Aristotle likened the mind to a muscle (Thornburg, 1984). It was held that like a muscle, the brain

needed exercise to develop it's innate potential. The more rigorous (tedious) the exercise, the greater the development. This theory is still widely held among educators (Thornburg, 1984).

Another learning theory supporting Rote Learning is Associationism, which views learning as the process of absorbing and combining irreducible elements of information (Thornburg, 1984). Knowledge or understanding occurs once these facts exist in sufficient quantity in the brain to allow enough associations to be made.

The British Empiricists also had a hand in supporting Expository Teaching styles. According to Locke and others, the mind is blank at birth. It is, however highly impressionable and may be filled in a nurturing learning environment (Thornburg, 1984). Again, knowledge, according to this philosophy, is thrust upon learners.

In the early nineteenth century, Herbert advanced the theory of Apperception, a forerunner to Stimulus-Response (Thornburg, 1984). This theory, like the others views learning as the addition of new ideas

to a growing body of knowledge already in the mind. Apperception suggests that the more often an idea enters the mind, the greater the chance of retention (ergo a need for repetition) and that the combined strength of like ideas in sufficient quantity causes their entry into consciousness (Thornburg, 1984).

Thorndike (1898) and later behaviorists theorized that reward had a great effect on learning. This Stimulus-Response theory made a strong argument for the use of extrinsic rewards in learning, which is still prevalent in American education (Thornburg, 1984).

These and similar prominent psychological theories had a powerful and lasting effect on the way many educators view learning. Despite being disproven by subsequent theorists and scholars (Bloom 1956, Dewey 1916, Keeton 1977, Bruner 1961, Ausubel 1968, Koffka 1925, Kohler 1935, and Piaget 1964), these misconceptions about learning are still pervasive. This is in part due to our society's archaic definition of knowledge (abstract, quantifiable facts) which leads instructors to create educational objectives solely within the domain of Lower Order Thinking, and in part

due to a cycle of Rote Learning justified by tradition. The dearth of information concerning Experiential Learning (in the form of literature concerning practical implementation, training, and classroom examples) is certainly another contributing factor.

Definition.

In defining Rote or Expository Learning the influence of the aforementioned learning theories is evident. Expository Learning involves the presentation of predetermined information by a teacher to a learner. Like a sponge the learner is expected to absorb this knowledge and later recall or recognize it. This learning is based in Lower Order Thinking and yields a low level of student understanding, relying instead upon simple memorization (Newmann & Wehlage, 1993).

Coverage of material is extensive but superficial and information is fragmented. Overriding significant concepts are ignored and disciplines are usually distinct and unrelated. Quantity of information rather than quality is usually stressed (quality meaning depth of understanding and use of Higher Order Thinking not

accuracy). Newmann & Wehlage (1993) state that Rote Learning emphasizes memorization, repetitive practice, silent study and brief exposure.

Boydell (1976) describes the product of Expository Learning as memory or habit. The learner, he asserts has the ability to "recall, repeat, quote, [and] describe facts, rules, procedures, principles, behaviors, skills, [and] tasks... [and] can make a 'correct' response ('correct' as defined and desired by the teacher)... without thinking" (p. 2).

Ausubel (1968) writes that Rote Learning fails to be meaningful (fails to have relevance beyond the classroom) and is therefore not generalizable. It is arbitrary, verbatim, and easily forgotten. He also says that Rote Learning is limited in that it must be recalled in a situation highly similar to the one in which information was learned.

Taylor (1993) condemns Expository Learning for it's highly symbolic nature which is far removed from the natural, Experiential Learning process. Rote Learning relies heavily upon verbal material whether spoken in a lecture or read from a text. Such verbal

knowledge is arbitrary (a learner cannot construct the word 'tree' for example) and thus meaningless. In Expository Learning, the emphasis is on the ability to describe a concept rather than the ability to understand or enact it. The fraudulence of this Rote approach to learning is clearly illustrated in the example of learning language itself. The child that can speak and write using grammatical rules can do so due to Experiential exposure and learning not because of arbitrary grammatical rules learned in a classroom. It is likely that the child would not even be able to articulate the rules being followed if asked, despite possible success on a Rote evaluation of grammatical rules. Again, Expository Learning is "mindless and contextless" (Brant, 1993, p. 6).

There are many names for Expository Learning but they all share the basic characteristics and shortcomings delineated above. Variations have their roots in the history and nature of Rote Learning: Scholarly Learning, Academic Learning, and Classical Learning (having their roots in Western infatuation with Greek/Latin philosophy), and ones having

descriptive functions: Rote Learning, Expository Learning, Direct(ed) Instruction, Deductive Learning, Passive Learning, Lecturing, Guided Instruction, Classroom Learning, Teacher-Directed Instruction, Fact Learning, Memorization, Teacher-Induced Learning, Symbolic Learning, Information Assimilation, Structured Learning, Linguistic Learning, and Declarative Learning.

The inadequacies of Rote or Expository Learning are apparent. It is arbitrary, descriptive, shallow, disjointed, meaningless, tedious, symbolic, easily forgotten (because it employs only Lower-Order Thinking skills), views the learner as passive, and fails to yield understanding.

Experiential Learning

Experiential Learning represents a philosophy of learning whose primary educational objective is understanding achieved through meaningful activities in an integrated curriculum with connections to real world application, depth of knowledge, interesting, non-symbolic (personal) mediums, and the employment of

Higher Order Thinking skills.

History.

The concept of Experiential Learning is not new; people have always learned from experience. Dewey (1916), Koffka (1925), Kohler (1935), Piaget (1964), Ausubel (1968), Simosko (1988), and others suggest that Experiential Learning describes the natural learning that occurs throughout most of our lives; it is intrinsic in the human experience. To attempt to learn by other means (i.e. symbolic media) is thus fraudulent because it circumvents the real human learning process.

The recognition and formal study of Experiential Learning occurs surprisingly early in the historical record. The ancient wisdom of this concept is found in a Chinese proverb:

Tell Me, I forget. (Rote/Symbolic Learning)

Show Me, I remember. (Rote/Memorization)

Involve Me, I understand. (Experiential Learning)

Even in this archaic source, the recognition of higher learning and thinking objectives has occurred; learning through involvement achieves student understanding.

Plato distinguished between the kind of knowledge that the vision of the Forms provided (arbitrary verbally-represented information) and that which guides action in the everyday world (Keeton, 1977). Ironically, he believed the Forms to be the more important. Plato in his Meno also provides an example of Experiential Learning in a story about Socrates. In this story, an uneducated slave boy is guided by Socrates to rediscover the Pythagorean Theorem (Keeton, 1977). The boy, though illiterate, possessed the basic knowledge required to solve this complex problem from his experiences and observations of life. Thus the boy's education in this instance was based upon his personal prior experience, and was an action that he experienced himself, rather than simply a lecture (to which he would have been a passive observer).

Experiential Learning was the basis for the apprenticeships of the Craft Guilds and chivalric education of nobles in Europe in the Middle Ages, existing simultaneously beside the newly-emerging lecture-based university system (Keeton, 1977). While the Craft Guilds and chivalric systems emphasized

practical application of their knowledge, the university system promoted verbally-based "scholarly" knowledge for its own sake.

Early in the emergence of the American collegiate system, it's leaders recognized the importance of experience in education. In 1871 a conference of American university presidents convened to discuss the need for Experiential Learning in the classroom. They came to the conclusion that in the study of the sciences, "we make the mistake in setting [a student] to learn from books... [science] cannot be put into a book, but is outside of it" (Keeton, 1977, p. 29). They agreed that a student must experience science, not simply study descriptions of it. This became the basis for the practicum, or guided simulation in such fields as medicine, law, and teaching (Keeton, 1977).

Dewey (1903, 1916, 1933, 1938) was one of the first to formally and eloquently define and espouse Experiential Learning. He emphasized the importance of students solving their own problems by examining many possible solutions and applying them. Dewey argued that education must be active and involved.

According to Dewey, knowledge must be linked to experience, not set apart in "abstract, bookish forms divorced from life" (Dewey, 1916, p. 8). Dewey contends that knowledge must be grounded in the "depth of meaning" normally associated with "urgent daily interests" (Dewey, 1916, p. 8).

Dewey (1938) asserts that formal education should prepare a person for later experiences in life as well as for further study in greater depth. He claims this to be the "very meaning of growth" (Dewey, 1938, p. 47). Dewey states that educators must eliminate the "gap" between experience and current (Rote) subject matter. He also promotes the abandonment of the notion of a fixed, ready-made, quantifiable body of knowledge, instead preferring to think of knowledge as experiential, fluid, embryonic and vital (Keeton, 1977).

Psychological Basis.

There is also a growing body of psychological evidence supporting Experiential Education over Expository Learning. This body of knowledge spanning

over eight decades of research on learning and cognitive development supports Experiential Learning as the natural process by which all true and lasting learning occurs.

Wertheimer (1938), Koffka (1925, 1935), and Kohler (1925) advanced a theory of learning based on perception and global structures of meaning in the brain. Their theory, called Gestalt (meaning "whole pattern" in German) centers on the idea that the learner gains insight by personally recognizing the whole conceptual pattern of what is being learned (Boydell, 1976). The concepts of thinking and puzzling are crucial to learning. The insight must come from within the learner; it cannot be "fed in" by someone else as Rote Learning assumes.

In Gestalt Learning, the learner is said to have whole, meaningful perceptions (awareness of the senses through external stimulation), attending to aspects of their environment that have significance to them already (i.e. that they have already had experience with). These perceptions are organized by the learner according to global patterns of thinking. People only

learn meaningful material (meaningful being the extent to which learning is useful in a person's life) (Thornburg, 1984). Key to Gestalt learning theory is the belief that these grand organizational structures are what allow insight, not the sum of the components of information (hence the name Gestalt: "whole pattern") (Thornburg, 1984). These grand patterns and their ability to organize and structure related components of perceptions are what makes learning relevant and meaningful.

Thus, according to the Gestalt theory of learning, an educational program is needed that involves active problem-solving and perception-creation through the senses instead of through symbolic mediums. This learning context is necessarily based on students' previous experience and facilitates insight by allowing students to construct meaning from perceptions as opposed to having pre-defined information forced upon them.

Another area of learning study that supports an Experiential model of education is Constructivism. The father of Constructivism is Jean Piaget (1964).

According to Piaget, the child learns about the environment through percepts. A percept is the impression of a stimulus obtained through the senses. These percepts may combine with mental images, verbal symbols and related information to form concepts, which are organizing structures (Sale, 1972). For example, a child learns the concept of "cat" by feeling its fur, seeing its form, smelling its odor and hearing its meow.

Piaget (1964) contends that a child's ability to understand broad concepts depends upon learning that evolves from direct sensory experience (current and prior) (Sale, 1972). Piaget states that learners do not simply accumulate thoughts (or pieces of information) obtained through the senses, but rather they evaluate them in light of existing mental structures (Thornburg, 1984). He explains that as individuals organize their thoughts and behaviors in order to adapt to their environment (learning) they create new psychological structures, schemes, which provide conceptual framework into which new environmental stimuli must fit if the learner is to

perceive and act upon them (Thornburg, 1984). Kant contributes to the understanding of this concept, saying that knowledge without experiential content is not truly knowledge and that "concepts without percepts are empty; percepts without concepts are blind" (Keeton 1977, p. 2).

Schemes change as a result of experience. This change is called learning. Learning occurs through disequilibrium that forces a child to reconcile stimuli that contradicts the preexisting schemes in the child's head (Dembo, 1991). If information or stimuli is in accordance with the child's current schemes, the child uses these to deal with the problem. This is called Assimilation and is not learning. If, however, the new information contradicts current schemes, the child must change the existing schemes in order to make sense of the novel data. This is termed Accommodation and may accurately be called learning. Therefore, a student must enter the unknown to learn; children must be confronted with the illogical nature of their point of view.

Due to an innate need for equilibrium, there

exists an intense need to accommodate and restore balance through activity (Sigel, 1984) This means that there is a strong desire for learning in all students if the environment is structured for Accommodation (Experiential Learning) as opposed to Assimilation (Rote Teaching).

Piaget's research shows that learning occurs within the context of natural cognitive development. Each child progresses through a series of sequential developmental stages, ranging from the ability to make concrete observations to the use of increasingly abstract modes of thought. As the learner advances through the stages, increasingly complex theories are created (Chaille & Britain, 1991). Mental growth in Piaget's model of learning is a qualitative change (acquisition of new mental abilities) rather than a quantitative one (accumulation of facts) (Dembo, 1991). Piaget contends that most elementary-age children are in the Concrete Operations stage of cognitive development, and therefore require highly concrete learning mediums in order to learn and develop (Chaille & Britain, 1991).

The child develops by recognizing and resolving the aforementioned discrepancies between what is expected based upon current base of knowledge (schemes) and what is occurring in the environment (Accommodation). This process is at the same time inhibited by the child's cognitive level of development. Discrepancy resolution is impossible unless the child is at a high enough level of development to recognize the discrepancy (Sigel, 1984).

Piaget's theory of learning and development shows that the child is an active constructor of knowledge. Children observe, hypothesize, and test in a never-ending cycle of learning through problem solving. In writing about the application of Piagetian theory, Chaille & Britain (1991) liken children to scientists in light of their theory-building, experimentation and continual reconstruction of their worlds. Chaille & Britain (1991) emphasize each learner's ownership of the fruits of their scientific inquiries.

Piaget categorizes knowledge into three categories: physical, logico-mathematical, and social (Chaille & Britain, 1991). He explains that physical

knowledge is an understanding of the physical world that is empirically learned, laying the foundation for later, less concrete knowledge. Physical knowledge is constructable by the child. Logico-mathematical knowledge is defined as non-observable knowledge involving the construction of relationships between objects through comparison and seriation. Logico-mathematical knowledge is also constructable and accounts for learning in that connections between physical observations are made in this level of knowledge through a series of logico-mathematical operations including association and reversibility (Dembo, 1991). Social knowledge is arbitrary, socially transmitted information including names, history, and symbolic information. This knowledge cannot be constructed because it is arbitrarily invented by a society (i.e. a child cannot construct the word "tree" from the object it represents). Due to the way in which children learn, instructors must expose them to lessons using knowledge that they can construct (i.e. physical and logico-mathematical). Currently, unconstructable social knowledge is emphasized in

schools. One of the few criticisms of Piaget's theory, that he overestimates the ability of adults to use (or even reach) highly abstract thinking, ironically strengthens the case for concrete (physically and logico-mathematically based), Experiential Learning (Dembo, 1991).

Discovery Learning (a name for Experiential Learning emphasizing its inductive nature) is a direct product of Piaget's theories. It views the child as an active thinker who must construct understanding of the surrounding world through experience. This notion implies that students should be active participants in the learning process rather than passive absorbers of information presented by teachers. As Piaget himself said, "good pedagogy must involve the child with situations in which he himself experiments" (Dembo 1991, p.61).

Kolb (1984) contributes to the Constructivist understanding of learning by delineating what he calls "modes of operation" in which learning occurs. Kolb (1984) agrees with Piaget that a defining characteristic of learning is the resolution of

"dialectically opposed modes of adaptation to the world" but he emphasizes the approaches that the learner takes towards resolving this conflict (p. 30). These modes can be described as styles of learning or an ongoing cycle. Learners, he argues, work in a variety of these modes which can include auditory, visual, kinesthetic, tactile, linguistic, symbolic, and other kinds of performance and exploration.

As the child progresses through Piagetian stages of development, Kolb (1984) asserts that movement occurs in varying degrees from actor (concrete experience) to observer (abstract conceptualization) and from specific involvement to general analytic detachment. Experiential Learning accommodates this spectrum of thought by allowing each child to construct knowledge at their own current level of abstraction.

Bruner (1960, 1966, 1971) provides further insight into the learning process. According to Bruner (1966) effective learning occurs when students acquire a "general understanding" of a subject. This general comprehension occurs when students understand the structure of a subject and see it as a related whole

(having relevance to other disciplines, other knowledge, and the outside world) (Bruner, 1960). They gain this understanding by building concepts, coding information, forming generalizations, and seeing relationships (Thornburg, 1984). Information acquired without structure and relevance is likely to be forgotten (Bruner, 1960).

Bruner (1966) divides knowledge into three categories according to level of complexity. The least complex level is called Enactive Representation, referring to information grasped through the senses and/or expressed in physical action (concrete). This also refers to understanding the principles of one activity by relating them to another. Bruner (1966) argues that whenever anyone learns anything completely novel or hard to visualize, they revert to this level.

The upper two levels of knowledge and complexity are Iconic Representation (representing objects and events concretely, as in maps, models and pictures) and Symbolic Representation (abstraction through language or ruled translation) (Bruner, 1966). Both are abstract and require a base of Enactive knowledge from

which to refer. Thus one benefits from using a learning methodology based in Enactive Representation such as Experiential Learning.

Bruner (1971) also states that the keys to learning are intuitive thinking and intrinsic motivation. Intuitive thinking, in which students discover reasons or answers for themselves leads to a type and depth of understanding that increases their desire to learn and makes them more self-sufficient in leaning. This self-sufficiency and resulting competence increases curiosity, leading to more intuitive thought. As Bruner (1971) states, learning cannot take place without student confidence and interest (p. 75)

Thus, Bruner (1960, 1961, 1971) argues for Experiential Learning because it allows students to work in whatever level of knowledge that they are comfortable instead of forcing them to work in the highly abstract Symbolic Representation level, it has intrinsic rewards, it provides for connection to the outside world, and students are more likely to remember things they have discovered. This notion is supported

by numerous subsequent studies that find that long term memory is better with conceptual than nonconceptual material (Bransford, Barclay & Franks, 1972; Bransford, McCarrell, Franks & Nitsch, 1977; Deci, Sheinman, Wheeler & Hart, 1980).

Hutchings & Wutzdorff (1988) agree that learning must be rooted in a students experience, be it in or out of the classroom. They have found that connecting a student's personal experiences to learning is something that the most skilled teachers do instinctively. They also agree that learning obtained through several modalities (simultaneously) is more lasting. Hutchings & Wutzdorff (1988) observed and defined the process of learning, which clearly supports Experiential Instruction. They propose that learning occurs in a series of non-sequential stages which are repeatedly transformed. These include doing, observation, trial and error, reflection, theory-building, and theory-testing. Such a combination of action and theory-testing is also outlined by Freire (1972) in his concept of Praxis.

Definition.

There are many names assigned to the concept of Experiential Learning. There are those which emphasize the authenticity of this learning approach: Real Learning, Natural Learning, Authentic Learning, Life Learning, Meaningful Learning, Qualitative Learning, Teaching for Understanding, Teaching for Thinking, and Teaching for Learning.

Other names highlight the Constructivist components of Experiential Learning: Discovery Learning, Constructivist teaching, Cognitive Learning, Inductive Learning, Developmentally Appropriate Instruction, Perceptual Learning, Disequilibrium Learning, Empirical Learning, Scientific Learning, Exploratory Learning, and Problem-Based Learning.

There are those emphasizing student involvement in the process: Student-Centered Learning, Student-Owned Learning, and Student Directed Learning.

And finally, there are names revolving around the active nature of Experiential Learning: Active Learning, Manipulative Learning, Hands-On Learning, Experiential Learning, Learning by Doing, Involved

Learning, Vocational Learning, Performance-Based Learning, Touch Learning, Museum Learning, Trail and Error Learning, and Participative Learning.

In conjunction with the Learning theories of the aforementioned researchers, Experiential Learning scholars have devised a myriad of definitions of Experiential Learning, each emphasizing certain aspects of the philosophy. Taken together, however, these provide a comprehensive, consistent, and clear definition of Experiential Learning.

According to Simosko (1988) and Taylor (1993) Experiential Learning utilizes the child's natural learning process as defined by the Gestalten, Cognitive and Discovery Learning theorists mentioned above. As this is how all true and lasting learning occurs, it is the model for Authentic Learning as well.

Kolb (1984), Garratt (1983), Seeman (1988), Hutchings & Wutzdorff (1988), and Pfeiffer & Goodstein (1982) all envision Experiential Learning as a continual cycle or process. This process entails concrete experience and observation-making, hypothesis-making and processing, sharing (or

discussion), hypothesis-testing, generalizing (or conceptualization and internalization), and application in novel situations.

Hutchings & Wutzdorff (1988), Dittmer, Fischetti, & Wells Kyle (1993), Simosko (1988), Taylor (1993), and Seeman (1988) agree that Experiential Learning is active because students learn best from activities that they themselves plan, carry out, and reflect upon. Experiential learning builds upon not only the activity at hand but also each student's prior experiences. To invalidate a student's experiences is to invalidate the student (Taylor, 1993). Such in class experience and its direct relation to previous learning provides for learning that is applicable outside of the classroom as well.

Dewey (1916), Deci, Schweinhart, & Hohmann (1992), Wight (1970) and Seeman (1988) all contend that effective Experiential Learning is reflective. As Dewey (1916) states, mere activity does not constitute Experiential Learning. Wight (1970) asserts that we seldom learn from experience unless we asses it, assigning it our own meaning, relating it to other

experiences, creating insight, discovery and understanding. Seeman (1988) contends that such reflection empowers the student, allowing ownership of the knowledge.

Experiential Learning necessarily includes depth of knowledge according to Newmann & Wehlage (1993), Deci, Schweinhart, & Hohmann (1992), Chaille & Britain (1991), Schnitzer (1993), and Keeton (1977). Experiential curricula are not superficial like current Rote studies (which present large quantities of fragmented information). Topics are conceptually organized, personally and communally significant and completely integrated (Newmann & Wehlage, 1993). Experiential Learning changes judgements, feelings, knowledge and skills from living through an event (Keeton, 1977). Higher-Order Thinking is emphasized and the curriculum teaches necessary thought processes as well as informational content in order to grasp the data and the relationships between them (Schnitzer, 1993).

According to Boydell (1976), Deci, Schweinhart, & Hohmann (1992), Strickland & VanCleaf (1985), Brant

(1993), Dittmer, Fischetti, & Wells Kyle (1993), and Seeman (1988), Experiential Learning involves discovery, inquiry, induction and problem-solving as the basis for instruction. In this method, concepts are discovered by each student not provided by an instructor. The curriculum provides models for problem-solving instead of acting as sources of information. Discovery Learning employs open-ended activities such as exploration, creating, problem-solving and communication instead of rote work. Independent thinking and each child's personal and active construction of knowledge are valued. The ultimate goal of Experiential Learning is to preserve the imagination and creativity of the child while gradually replacing ill-founded ideas with ones which are more accurate (Seeman, 1988).

The Experiential curriculum is meaningful, meaning it is connected to the outside world (Newmann & Wehlage, 1993; Strickland & VanCleaf, 1985; Boud & Pascoe, 1978; Dittmer, Fischetti, & Wells Kyle, 1993; Ausubel, 1968). It utilizes students' personal experiences as the context for the application of

knowledge and has value and meaning beyond success in school. This does not mean that all activities have to be totally authentic (i.e. learning a language only in a foreign country), only that they are as real as possible. Ausubel (1968) says that meaningful learning must meet three criteria: Logical Meaningfulness (within learner's capabilities to comprehend), Potential Meaningfulness (the capacity to relate new learning to what the learner already knows and to use as guide for future action), and the Intent to Integrate new knowledge into the existing structure.

Newmann & Wehlage (1993), Boud & Pascoe (1978), Deci, Schweinhart, & Hohmann (1992), Dittmer, Fischetti, & Wells Kyle (1993), and Brant (1993) include student involvement, interaction and control as key factors in Experiential Learning. The curriculum is not prescribed and rigid but is instead responsive to the needs, interests, and capabilities of the students. It engages the full attention of each student through involvement with the material and each other. There is substantive conversation between students and with the instructor. Above all, it

provides an environment with high expectations, little competition, respect, safety and the inclusion of all students (Newmann & Wehlage, 1993). All students feel safe to contribute.

Finally, Experiential curriculum allows children to explore topics using a wide variety of learning modes (Dittmer, Fischetti, & Wells Kyle, 1993; Brant, 1993; Seeman, 1988; Hutchings & Wutzdorff, 1988; and Boud & Pascoe, 1978).

The role of the teacher in Experiential education is seen as that of an active facilitator or orchestrator, versus the traditional role of a teacher (a transmitter of knowledge) (Chaille & Britain, 1991). As such the facilitator is responsible for setting up the educational context (using students' experiences as basis for all learning), maintaining classroom routines that provide for active learning, observing the students as they engage in active learning to determine developmental levels and asses student learning, interacting when it encourages theory-building, modifying activities based on student interest and observed learning, and supporting children in their

social interactions if needed (Chaille & Britain, 1991; Deci, Schweinhart, & Hohmann, 1992). Like the child, the teacher must be a theory-builder in Constructivist Learning. The instructor must have the courage to experiment, be reflective, and change according to findings (Chaille & Britain, 1991).

Field Research.

Recent findings of studies done on topics concerning Experiential Learning support that Experiential Learning is the natural and thus most appropriate learning method for children. Studies indicate that the type and quality of instruction has a greater effect on learning than changes in the amount or quantity of instruction. This explains why the myriad of educational reforms based on more of the same type of instruction (Rote) have been thus far ineffectual (Von Eschenbach & Ragsdale, 1989). Clearly changes in the overriding philosophy of instruction are required.

Accordingly, a study done by Dittmer, Fischetti, & Wells Kyle (1993) indicates that many students

construct their understandings more effectively when instruction is in a less structured and controlled setting (such as in Experiential Learning). In fact, a study chronicled by Bennett (1993) gives evidence that students only remember 42% of material presented to them in lecture and textbook form while they retain over 80% of the material when it is experienced.

As stated previously, the freedom of modality allows students to customize learning to their own strengths and developmental level. Newmann & Wehlage (1993) found that teaching for thinking and problem-solving has greater positive effects on student achievement than traditional instructional methods. Studies conducted by Von Eschenbach & Ragsdale (1989), Greenockle & Lee (1991), Chaimberlin (1979), Galvin (1986), Grey & Semchuck (1980), McGowan & Sesow (1987), McQuarrie (1981), O'Toole (1981), and Strickland & VanCleaf (1985) found that students are more attentive and achieve deeper understanding and insight into concepts attained through Experiential Instruction than through Expository Learning. The scores on Experiential Learning tests were on average 20% - 30%

higher and the range of scores was much less expansive than those for Rote Instruction.

In the study conducted by Greenockle & Lee (1991), subjects using Experiential Learning methods showed a steady increase in performance on a psychomotor task while the Guided (Expository) Learning group showed continued variability on scores. Hutchings & Wutzdorff's study (1988) showed that through constant practice of Experientially-based problem-solving skills, an Experimental group gained greater involvement, reflection and abstraction abilities and could reason at higher levels of thought and complexity.

Research has also suggested many affective benefits of Experiential Learning as well. A study presented by Bennett (1993) shows that in lecture format lessons, students are passive and attention wanes within 10 minutes for adults (a child's attention span would presumably be even shorter). Keeton (1977) found that Experiential Learning provides intrinsic motivation through interpersonal interaction and self confidence. In a study of student's perceptions of

Experiential Learning, LaRocca (1993) reports that 83% of her students stated that the method of instruction positively effected their attitudes towards the discipline; 99% stated that it positively effected their achievement; and 95% stated that it made a positive lasting impression concerning the lesson itself.

In studies conducted by Deci, Schweinhart, & Hohmann (1992) and Keeton (1977), Experiential Learning was found to have positive effects on the motivation and achievement of unmotivated and slow-learning students. Keeton (1977) theorized that it was due to the choice of modalities afforded by Experiential Learning. These students perform poorly on Rote tests because the learning and assessment only functions in the abstract symbolic modality, circumventing the natural learning process, and providing no intrinsic motivation. Deci, Schweinhart, & Hohmann (1980) state that Discovery Learning's experience base and multi-modality approach can help reach the great diversity of students in our classrooms because it allows them all to learn in their own modality.

Despite the convincing growing body of research supporting Experiential Education, a recent report from the national Assessment of Educational Progress reveals that elementary school teachers still use textbooks, lectures, and work sheets as the major vehicles for instruction (Von Eschenbach & Ragsdale, 1989). There are several reasons for this resistance to Experiential Education. Firstly, our society is still heavily influenced by the Platonic definition of knowledge; memorizing abstract quantifiable facts is deemed "real scholarship," deriding the inclusion of subjectivity and non-symbolic knowledge forms (i.e. Experiential Knowledge) (Seeman 1988, p. 28).

For instructors that are interested in implementing Experiential Learning there are practical barriers. Many teachers feel improperly trained for Experiential Instruction. It requires teachers to use non-traditional instructional methods that they are unfamiliar with. Also, there are a dearth of living examples of fully integrated Experiential Learning and practical implementation guides are rare (Seeman, 1988). Although Constructivism is being increasingly

taught in pre-service teacher training, it is often taught impractically, resulting in behavior problems and implementation difficulties in real classrooms. New teachers invariably resort back to more traditional, Rote methods seeking the safety of structure of teacher dominance (Veenman, 1984; Kremer-Hayon & Ben-Peretz, 1986). Veteran instructors who attempt Experiential Learning are equally likely to revert back to Expository Instruction when confronted with the many possible difficulties associated with the initial implementation of any unfamiliar instructional methodology.

Experiential Learning can also be far more time-consuming in terms of both preparation and implementation (Seeman, 1988). Teachers are often faced with administrative and budgetary resistance and constraints, as well as negative attitudes towards unfamiliar Experiential techniques from skeptical colleagues (Seeman, 1988). Still other teachers have misconceptions concerning the extent of authenticity, creativity, and complexity required, assume they cannot do it, and give up (Cronin, 1993).

## Method

### Subjects

20 subjects participated in this study. All were third-grade students enrolled in a the same class in a suburban public elementary school in Central Virginia. The class and grade were selected due to the experimenter's knowledge of the students and classroom environment through student teaching in the previous semester.

Ages of the participants ranged from 8 to 9. There were 10 females and 10 males. 12 of the subjects were Caucasian and 8 were African-American. 7 of the participants were from high socioeconomic backgrounds, 6 from mid-range SES, and 8 from low SES. Of the 8 students from low SES, 8 received free or reduced lunch in school. In terms of ability level, 9 were high (of those, 6 were in a gifted pull-out program), 5 were mid-range, and 6 were low (4 of which were receiving remedial services through the school).

The participants were divided as equally as possible in terms of gender, race, age, SES, and ability level into 2 heterogeneous groups. The Control

group was comprised of 10 subjects: 5 males, 5 females; 6 Caucasians, 4 African-Americans; 5 9-year-olds, 5 8-year-olds; 4 high SES, 2 mid-range SES, 4 low SES; and 5 high ability level, 2 medium ability level, 3 low ability level.

The experimental group was comprised of the 10 remaining subjects: 5 males, 5 females; 6 Caucasians, 4 African-Americans; 6 9-year-olds, 4 8-year-olds; 3 high SES, 3 mid-range SES, 4 low SES; and 4 high ability level, 3 medium ability level, 3 low ability level.

## Procedure

The participants were divided as equally as possible in terms of gender, race, age, SES, and ability level into 2 heterogeneous, 10-person groups. At random, one was chosen to be the control group and the other the experimental group. Neither group was informed of their group membership, nor their participation in the "lesson" (experiment) until the time of the study. The study took the form of formal classroom science instruction.

Each group participated in their respective lessons during the afternoon as the final activities of the day. In both cases the experiments were conducted in the students' own classroom, while the rest of the class was participating in the same outdoor activity with the cooperating instructor.

The creation of the Expository and Experiential lessons was guided by identical content objectives concerning "air." The control group participated in the Expository lesson, while the experimental group participated in the Experiential lesson.

The control (Expository) lesson consisted of lecture, note-taking, reading, viewing diagrams, answering and asking questions, filling-out worksheets, memorizing facts and vocabulary. The experimental lesson was comprised of 10 discrete hands-on experiments that the students carried-out alone, in small groups, and as a class. Written documentation was kept by each student to record hypotheses and results. Discussion, interaction, questioning and experimentation were encouraged during this lesson. Neither lesson had a time limit. Each student was

allowed to progress through the lesson at their own rate, and each lesson ended only after all students had completed their work.

Immediately following participation in their respective lessons, the control and experimental groups performed an identical written assessment tool devised to measure their comprehension of the content objectives for the lessons. This tool was read aloud to eliminate any variance or problems associated with reading difficulties or misunderstanding the questions. Students were allowed to ask questions to clarify assessment items. The assessment tool was divided into 2 parts (unbeknownst to the participants). The first part tested only Lower Order Thinking and Learning (as defined by Bloom), and the other half assessed Higher Order Thinking and Learning (Bloom). Students were given unlimited time in which to complete this assessment.

## Analysis

The assessment scores were analyzed in three different ways. First, each student's overall score

(Higher Order Thinking and Lower Order Thinking) was calculated (%), averaged and compared across groups in terms of mean scores, median scores, mode scores, and ranges of scores. The analysis of the tests was also broken-down into Lower Order and Higher Order Thinking components. Again, the mean scores, medians, modes, and ranges of scores were compared across groups.

## Results

The purpose of this study was to determine whether Experiential Learning produces deeper understanding of taught concepts than traditional, Expository methods of instruction. I hypothesized that Experiential Learning would indeed produce deeper learning, and thus higher scores on Higher Order components of the assessment as well as higher overall scores (incorporating Higher and Lower Order Thought questions) due to dramatically superior performance on the Higher Order Thought section. I also predicted that scores on the Lower Order portion of the assessment would be lower for the Experiential group due to a lack of focus on arbitrary social knowledge normally associated with Expository

Learning.

My first two hypotheses were supported by my findings, but my third was not. In every case, the experimental group outperformed the control group:

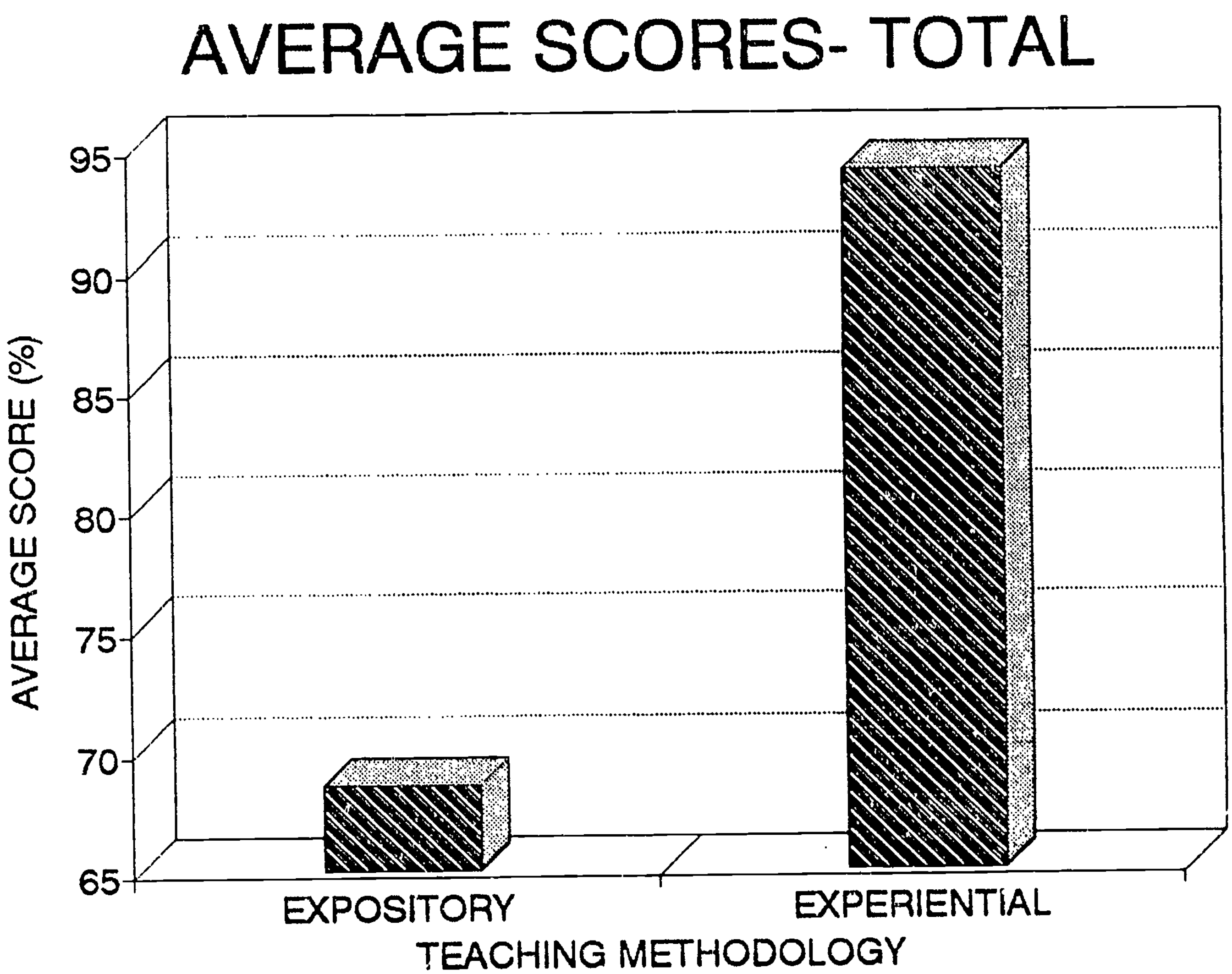
Table 1

Mean, Range, Mode, & Median (%) - Control and Experimental Groups

| | MEAN | RANGE | MODE | MEDIAN |
|---|---|---|---|---|
| **CONTROL** | | | | |
| **LOT** | 85 | 62.5-100 | 87.5 | 87.5 |
| **HOT** | 46.7 | 0-91.7 | 50/58.3 | 50 |
| **TOTAL** | 68.6 | 42.9-89.3 | 78.5 | 73.2 |
| **EXPERIMENTAL** | | | | |
| **LOT** | 96.3 | 87.5-100 | 100 | 100 |
| **HOT** | 91.7 | 66.7-100 | 100 | 100 |
| **TOTAL** | 94 | 78.6-100 | 100 | 97.2 |

In terms of overall performance, the members of the experimental group did an average of 25.4% better than their peers in the control group. The spread of the

Figure 1


AVERAGE SCORES- TOTAL
AVERAGE SCORE (%)
95
90
85
80
75
70
65
EXPOSITORY
EXPERIENTIAL
TEACHING METHODOLOGY

overall range was 46% smaller for the experimental group than the control group. The median score was 24% higher for the experimental group than for the control group and the mode was 78.5% for the control group and 100% for the experimental.

In terms of performance on just the Higher Order Thinking component of the assessment, the experimental group did 45% better on average, and the spread of their range was 58.4% smaller than that of the control group. The experimental group's median score was 50% higher than the control group's. The mode was 100% for the experimental group and 50% & 58.3% for the control group.

On the Lower Order Thought questions, the experimental group performed an average of 11.3% <u>better</u> than the control group, disproving my hypothesis concerning this section. The spread of ranges was 25% smaller for the experimental group and the their median score was 12.5% higher. The mode for the experimental group was 100% while their counterparts in the control group only scored an 87.5%.

Figure 2

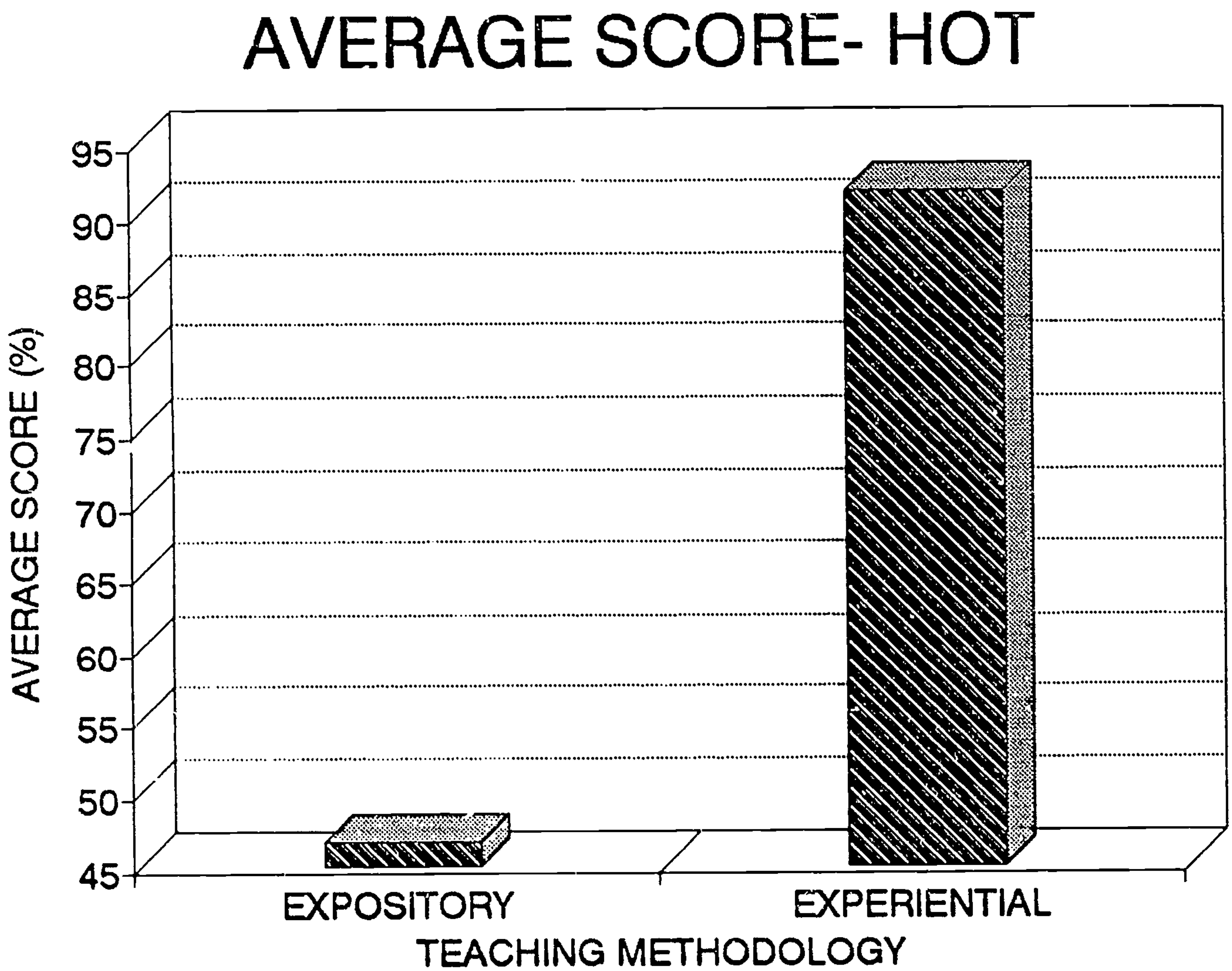
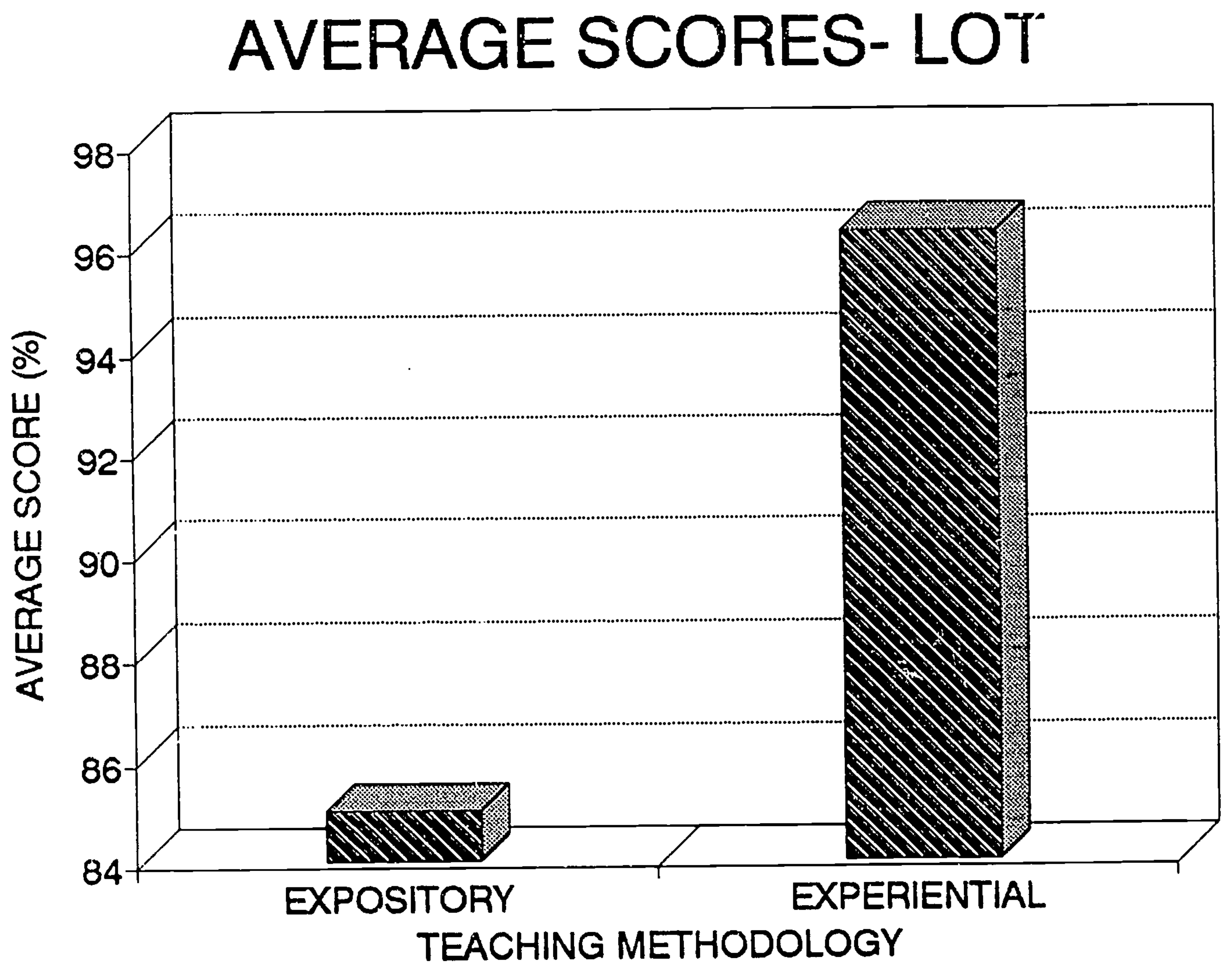

AVERAGE SCORE- HOT
AVERAGE SCORE (%)
95
90
85
80
75
70
65
60
55
50
45
EXPOSITORY
EXPERIENTIAL
TEACHING METHODOLOGY

Figure 3


AVERAGE SCORES- LOT
98
96
94
92
90
88
86
84
AVERAGE SCORE (%)
EXPOSITORY
EXPERIENTIAL
TEACHING METHODOLOGY

Discussion

The contention that children attain deeper and Higher Levels of learning through Hands-On, Experiential Learning is supported by this study. Specifically, several conclusions can be reached based upon the data obtained through the assessment of student learning following the control and experimental lessons:

Experiential Learning produces the attainment of higher test scores than Expository Learning at both the Higher and Lower Order ends of the spectrum of thought as outlined by Bloom. This means that using Hands-On Learning techniques can raise students' test scores according to traditional content objectives and means of assessment (arbitrary, rote knowledge), as well as more lofty educational goals: increasing true student <u>understanding</u> and ability to use learned information creatively in novel situations (such as in their own lives).

The less expansive and higher-placed range for the experimental group suggests that Experiential Learning

is an effective method for reaching learners of all ability levels. In the experimental group, even scores of the low achievers were drastically increased.

There are many possible explanations for these dramatic results and conclusions. This study supports the assertion that Experiential Learning is rooted in the natural learning process of all humans. Thus, using said teaching methodology would obviously produce a greater quantity and quality of thought than would a methodology that circumvented this natural design (such as lecturing). The act of discovery and active participation in the learning process allow the learner to fully utilize their innate cognitive potential.

Experiential Instruction also has many advantages over Expository Learning concerning content presentation. The material in Experiential Learning is organized conceptually, allowing the learner to make better sense of it through meaningful connections to other aspects of the material as well as to past learning (connectedness to the outside world). In this way it is meaningful, relevant, memorable and applicable to novel situations. The acts of discovery

and problem-solving in this methodology also promote Higher Order Thought, which as Piaget, Bloom, Kolb, and countless others contend is the only true route to true understanding.

The interaction of the learner with other learners and with the instructor in Experiential Learning serves to reinforce and clarify learned concepts. It is widely contended that the best way to learn material is to teach it. The discussions, debates and further definitions and discoveries help the learner achieve deeper understanding.

Experiential Learning is also inherently multimodal, allowing the learner to approach the material form a variety of learning styles (i.e. visual, auditory, symbolic, tactile, kinesthetic, etc.). This allows each learner to focus-on and benefit from whatever learning modes/styles that they are most comfortable with. The significantly wider variation of test scores (ranges) in the control group might be explained by the fact that lecture instruction only accommodates verbal and auditory learners, while those needing more visual, tactile, or kinesthetic

learning might not have been as successful in learning the presented material. The variety and flexibility of learning experiences in the experimental group would be more accommodating to all styles of learners, accounting for the smaller variation of test scores (ranges).

Based upon these findings, it is apparent that the American educational system is doing its students an injustice by forcing upon them an invalid form of instruction that circumvents their natural learning process. Thus I assert that our educational system must reevaluate our outmoded definition of "knowledge" (quantifiable abstract facts) and promote another that is aligned with our natural learning processes (constructable, observable information). Following this redefinition of knowledge, the entire educational system could finally recognize and make use of children's natural cognitive processes through system-wide Experiential Education.

Barring that, however, teachers can greatly improve both traditional (rote) and Higher Order based academic achievement within our current system if

higher test scores are what is to be valued. Despite greater cost in terms of time (3 times more than the control group) and money (18 times more), Hands-On Learning does yield achievement significantly high to warrant its use over Expository methods.

## Limitations of Study

The scope of the study is its greatest limitation. Due to time constraints imposed by the program for which this study was conducted, the sample is limited to one class in one school in a single area. The possibility to prior knowledge concerning the subject matter covered in the lessons is another concern. The design of the assessment tool is also a limitation. Assessing Higher Order Thought through the form of a partially standardized test is limiting and somewhat contradictory to the philosophy of Higher Order Thought.

## Future Research

Aspects of Experiential Learning that require further study include student performance on an entire

unit of Experiential Instruction, retention over time, the effectiveness of Expository versus Experiential Learning within an equal time limit, the affective benefits of Experiential Learning in students and teachers, valid assessment techniques for Experiential Learning, Experiential Learning at different ages (levels of abstraction), Hands-On Instruction concerning different content areas, ehavior management and Active Learning, Cooperative Learning's effect on Experiential Learning, and pure Experiential and Expository Learning versus mixed variations of the two.

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## Appendix

Table 2

Assessment Scores (%) - Control Group

| STUDENT | LOT | HOT | TOTAL |
|---|---|---|---|
| 1 | 87.5 | 66.7 | 78.6 |
| 2 | 87.5 | 50 | 71.4 |
| 3 | 75 | 33.3 | 57.1 |
| 4 | 100 | 50 | 78.6 |
| 5 | 75 | 41.7 | 60.7 |
| 6 | 87.5 | 58.3 | 75 |
| 7 | 62.5 | 16.6 | 42.9 |
| 8 | 100 | 58.3 | 82.1 |
| 9 | 87.5 | 91.7 | 89.3 |
| 10 | 87.5 | 0 | 50 |

Table 3

Assessment Scores (%) - Experimental Group

| STUDENT | LOT | HOT | TOTAL |
|---|---|---|---|
| 11 | 87.5 | 66.7 | 78.6 |
| 12 | 87.5 | 100 | 92.8 |
| 13 | 100 | 100 | 100 |
| 14 | 100 | 91.7 | 94.4 |
| 15 | 100 | 100 | 100 |
| 16 | 100 | 100 | 100 |
| 17 | 100 | 100 | 100 |
| 18 | 100 | 100 | 100 |
| 19 | 87.5 | 91.7 | 89.3 |
| 20 | 100 | 66.7 | 85.7 |

Table 4

Time (min.) and Cost ($) of Instruction - Control & Experimental

| | TIME | COST |
|---|---|---|
| CONTROL | 45 | 2 |
| EXPERIMENTAL | 125 | 35 |

Lesson Plans

# AIR

**Objectives:**

1. Through a brief introductory (expository or hands-on) lesson, students will gain basic knowledge of the nature, chemistry and behavior of air.

2. Specifically, students will learn that:
   a. Air takes up space
   b. Air fills voids
   c. Air has weight
   d. Air is made-up of tiny particles (molecules)
   e. Air molecules can be felt in wind
   f. Floating air molecules exert pressure in all directions
   g. Hot air is less dense (more spread-out) than cold air
   h. Hot air takes up more space than cold air
   i. Hot air weighs less & floats to top of cold air
   i. Air expands as it rises (less dense)
   j. Moving air is less dense than still air

3. Students in the expository group will learn these concepts through participation in lecture, reading, looking at diagrams and rote work

4. Students in the constructivist group will learn these concepts through participation in hands-on activities using scientific method (i.e. hypothesize, conduct experiment, observe, analyze results).

5. Both groups will demonstrate their comprehension/understanding of the material on the same orally presented written assessment tool testing Lower Order Thinking skills (knowledge, comprehension and application) as well as Higher Order Thinking skills (analysis, synthesis and evaluation).

Assessment Instrument

## AIR QUIZ

name ------------------------------------

PART A

1. (True or False) Air is made-up of tiny balls called molecules.

2. (True or False) An empty desk is really full of air.

3. Circle the box with cold air in it.

4. (True or False) Air has weight.

5. Air balls press on you:
   (a) down only
   (b) up only
   (c) from all directions

6. (True or false) Wind "blows" leaves around because moving air balls are hitting them.

7. Hot air:
   (a) rises ABOVE cold air
   (b) sinks BELOW cold air

8. Circle the bottle that shows the correct sizes of an air bubble floating from the bottom to the to the top of a bottle of oil.

PART B

1. The first submarines were just large bells that people hung on to the inside of as they went down into the sea. Explain how this could work. How could the people breathe and stay dry?

2. If you put a balloon that was filled with air into the freezer, what would it look like? Circle what it would look like.

3. Shanika thinks that the air at the TOP of a room is <u>hotter</u> than the air near the floor. Is she right? Why?

4. How does a hot air balloon work?

5. Joey thinks that if he puts a tissue paper in the bottom of a cup and puts it into water upside down, the tissue will get wet. Is he right? Why?

6. Beth says that the air in a big room can weigh over 160 pounds (more than a teacher!). Do you think this could be true? How?